
Chapter 7 — DTI Maintenance

Overview

From a maintenance perspective, Option 11 DTI operation consists of the following major aspects:

- hardware and software states
- near-end and far-end status
- link and/or span integrity
- clocking status
- frame alignment

Option 11 DTI operation is monitored and reported on through maintenance messages, out-of-service alarms, and circuit card faceplate LEDs.

Option 11 maintenance provides several tools, either manual or automatic, for maintaining effective DTI operation. These tools are service change and maintenance commands that are accessible through the software overlays and resident diagnostic routines.

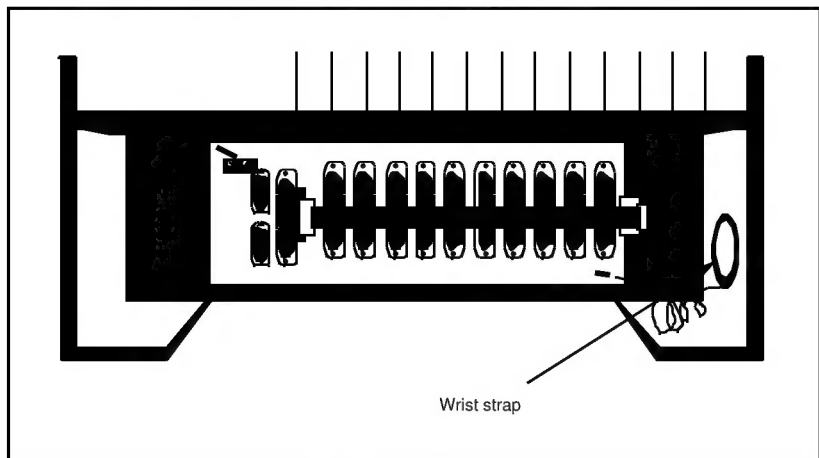
Replacing the NTAK10 2 Mb DTI card

To replace a DTI circuit pack, follow the procedure below:

- 1 Software disable the NTAK10 2 Mb DTI card(s) using overlay 60 (command DISL N, where N is the 2 Mb DTI card number).
- 2 Software disable the clock controller using overlay 60 (DIS CC 0).
- 3 Hold the NTAK10 by the lock latches, unlock the latches and slide the card out of the cabinet. Once out of the slot you may remove any of the daughterboards.

To avoid damage to the circuit cards from electrostatic discharge, wear the wrist strap connected to the inside of your Option 11 cabinet whenever handling the circuit cards. Figure 73 shows the location of the wrist strap in relation to the cabinet.

Figure 73
Wrist strap connection to the Option 11 cabinet



- 4 Slide the new card into the cabinet and lock the latches.
- 5 Software enable all NTAK10 2 Mb DTI cards using overlay 60 (command ENLL N, where N is the 2 Mb DTI card number).
- 6 Software enable the clock controller using overlay 60 (ENL CC 0).

- 7 Enable clock tracking on primary digital loop by issuing the following command TRCK PCK.

Monitoring Option 11 DTI operation

Maintenance messages

2 Mb DTI status and error conditions are reported in the following types of messages. Additional information on DTI messages can be found in the Option 11 Software Guide.

Table 29
Maintenance messages

Message	Meaning
DTA	Digital Trunk Alarms (Resident Monitor)
DTI	Digital Trunk Interface

2 Mb DTI Error messages

The Digital Trunk Interface diagnostic program (LD60) is used to maintain the NTAK10 2 Mb DTI Interface Card.

Comprehensive lists of the self-test failure codes for the NTAK10 2 Mb DTI follow the self-test description, later in this chapter.

Grade-of-Service messages

Grade-of-Service messages (DTA XXX) provide near and far end switch status. A summary of these status messages is as follows:

Status	2 Mb DTI Capability
Acceptable	Both incoming and outgoing calls allowed
Maintenance	Both incoming and outgoing calls allowed
No new data calls	No new outgoing data calls
No new calls	No new outgoing data or voice calls
Out of Service	2 Mb DTI is disabled

2 Mb DTI Alarms

There are two groups of alarm indicators monitored by the 2 Mb DTI. Within these two alarm groups there are several individual alarm types.

Group I alarms are event driven and include indicators that decrement a counter whenever an error is detected. Grade-of-service is changed based on how quickly the threshold of the counter is exceeded. The threshold count is determined in LD73 and downloaded to the 2 Mb DTI. Group 1 alarms are:

- 1 Bipolar Violations (BPV)—Near End Alarm
- 2 Slips (SLP)—Near End Alarm
- 3 Frame Alignment Problems (FAP)—Near End Alarm
- 4 Cyclic Redundancy Check (CRC-4)—Near End Alarm

Group II alarm indicators may be either continuous or spurious. Grade-of-service is changed based on the duration of the alarm within a defined period of time. A minimum persistence time is defined in LD73 and downloaded to the 2 Mb DTI.

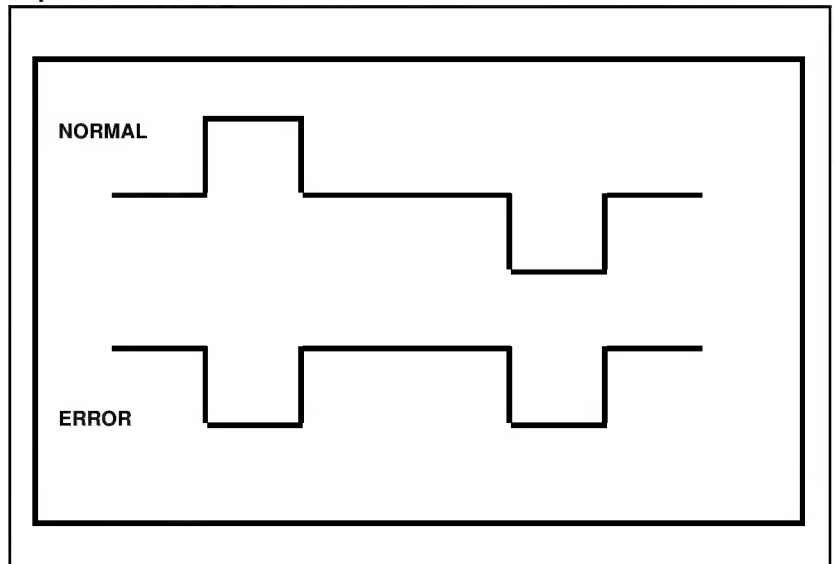
Group II alarm types are listed from high to low priority. A Group II alarm type may not be reported when a greater type is detected.

- 1 Alarm Indication Signal (AIS)—Far End Alarm
- 2 Loss of Frame Alignment Signal (LFAS)—Near End Alarm
- 3 Loss of Multiframe Alignment Signal (LMAS)—Near End Alarm
- 4 Loss of CRC-4 Multiframe Alignment Signal (CFAS)—Near End Alarm
- 5 Remote Alarm Indication (RAI, B3)—Far End Alarm
- 6 Remote Yellow Alarm (B6)—Far End Alarm
- 7 Alarm Indication Signal, 64 Kilobit (AIS 64)—Far End Alarm

Group I

Bipolar violation (BPV) In a bipolar pulse stream, pulses alternate in polarity. A bipolar violation has occurred if, after transmission, two pulses of the same polarity are received in succession (this could be caused by an electrical disturbance such as noise).

Figure 74
Bipolar violations



Cyclic Redundancy Check (CRC-4) When the 2 Mb DTI card is running in CRC-4 mode, the CRC-4 word contains a checksum of all data in the multiframe. The receiving side uses the checksum to verify the data.

The primary difference between BPV and CRC is that bipolar violation tracking indicates errors in the local span, while CRC indicates errors on an end-to-end span. For example, on a satellite link, BPV only detects errors in the span between the Meridian 1 and the satellite connection. Since CRC traverses the entire span, it indicates an end-to-end bit error rate.

Slip (SLP) Digital signals must have accurate clock synchronization for data to be interleaved into or extracted from the appropriate timeslot during multiplexing and demultiplexing operations. A Frame slip is defined as the repetition of, or deletion of 256 bits (one frame) due to a discrepancy in the read and write rates at the buffer (clocks aren't operating at EXACTLY the same speed)

When data bits are written into (added to) a buffer at a slightly *higher* rate than that at which they are being read (emptied), sooner or later the buffer overflows. This is a slip-frame deletion.

In the opposite situation, when data bits are written (added) into a buffer at slightly *lower* rate than that at which they are being read (emptied), eventually the buffer runs dry or underflows. This is also a slip-frame repetition.

All of the degradations shown in Table 30 can be controlled or avoided by proper clock (network) synchronization.

Table 30
Performance Impact of one Slip.

Service	Potential Impact
Encrypted Text	Encryption key must be resent.
Video	Freeze frame for several seconds. Loud pop on audio.
Digital Data	Deletion or repetition of Data. Possible Misframe.
Facsimile	Deletion of 4-8 scan lines. Drop Call.
Voice Band Data	Transmission Errors for 0.01 to 2 s. Drop Call.
Voice	Possible Click

Clock synchronization can be either tracking, on the primary or secondary reference clock, or free run (non-tracking). In LD 73 (prompts PREF and SREF), the 2 Mb DTI which supports the active clock controller is defined as the primary clock reference. Another 2 Mb DTI may be defined as the secondary clock reference. The clock controller synchronizes from the primary or secondary's incoming pulse stream. The clock controller in turn supplies clocking to all the other 2 Mb DTI cards.

2 Mb DTI hardware detects frame slips in tracking and free run modes. For tracking mode, running the midnight routines prints the number of overflows and clears the counter. For free run mode, running the midnight routines prints the number of slips and clears the counters.

Frame Alignment Problem (FAP) A Frame Alignment Problem is counted when a bit error occurs within the framing pattern.

Group II

Loss of Frame Alignment Signal (LFAS) A Loss of Frame Alignment condition can be defined as: frame alignment is lost on three consecutive frame alignment errors. This condition may occur as a result of the far end of the E1 span going completely out of service.(due to a power interruption, for example) or any other reason resulting in losing the incoming pulse stream. The B3 alarm is sent to the far end after the persistence time expires.

Loss of frame alignment thresholds 2 Mb DTI hardware detects out of frame conditions. Running the midnight routines prints the number of occurrences when frame alignment was lost and clears the counters.

Alarm Indication Signal (AIS) AIS is defined as receiving all ones without framing. The detection algorithm for AIS is two or less zeros per two frames. This allows detection of AIS in the presence of a $10E-3$ error rate, without mistaking framed all 1s for AIS.

When the AIS is detected, the prompt maintenance alarm indication associated with LFAS and excessive bit error rates should be inhibited. B3 alarm is sent to the far end after persistence time expires

Alarm Indication Signal 64 Kilobit (AIS64) There are also specific AIS requirements for CNET (France). The first requirement relates to the transmission of AIS in TS16. In that case, all 1 should be transmitted in the event abcd signaling cannot be supported.

With respect to the reception of AIS in TS16, AIS 64 Kbits must be detected when multiframe alignment has been lost and the binary content of TS16 is 95% 1, counting on 256 or 512 bits.

When AIS in TS16 is detected, then bit 6 of outgoing TS16 frame 0 should be set. When the fault disappears, it should then be cleared. Setting and clearing bit 6 of TRS 16 frame 0 must follow changes in status of the fault by less than 100 msec.

Other requirements when AIS 64 Kbit is detected include setting an LED, printing a TTY message and the updating of present status and history files. When a fault is detected, further changes in other error types should continue to be reported.

Loss of Multiframe Alignment Signal (LMAS) This condition is sometimes called a multiframe yellow alarm. An LMAS occurs when two consecutive multiframes contain errors in their Multiframe Alignment Signal, or when all TS16 bits are zero for at least one multiframe.

B6 alarm is sent to the far end after persistence time expires. If the option is enables, B3 alarm is also sent.

Loss of CRC-4 Multiframe Alignment Signal This condition is declared when the CRC-4 multiframe search fails to recognize two valid multiframe alignment words within 8 msec. This category is only relevant however, when CRC-4 option is selected.

B6 alarm is sent to the far end after persistence time expires. If the option is enables, B3 alarm is also sent.

Remote Alarm Indication (RAI) Bit 3 of TS0 in non-FAS frames is set to “1”. This alarm is sometimes called a yellow alarm. The far end is receiving AIS.

Remote Yellow Alarm (B6) Bit 6 of TS16 in Frame 0 is “1”. This alarm occurs when the far end has detected a loss of MFA.

NTAK10 Faceplate LEDs

The NTAk10 2 Mb DTI circuit card has a total of six LEDs on its face. Five of the LEDs are directly associated with the operation of the NTAk10 2 Mb DTI circuit card. The remaining LED is associated with the on-board clock controller. Following is a table of the LEDs found on the NTAk10 2 Mb DTI circuit card and the meaning of each:

LED	State	Definition
DIS	On (Red)	The NTAk10 2 Mb DTI circuit card is disabled
	Off	The NTAk10 2 Mb DTI is not in a disabled state
OOS	On (Yellow)	The NTAk10 2 Mb DTI circuit card is in an out of service state.
	Off	The NTAk10 is not in an out of service state.
NEA	On (Yellow)	A near end alarm state has been detected
	Off	No near end alarm
FEA	On (Yellow)	A far end alarm state has been detected
	Off	No far end alarm
LBK	On (Yellow)	NTAk10 2 Mb DTI is in loop-back mode
	Off	NTAk10 2 Mb DTI is not in loop-back mode
CC	On (Red)	The clock controller is switched on and disabled
	On (Green)	The clock controller is switched on and is either locked to a reference or is in free run mode
	Flashing (Green)	The clock controller is switched on and locking onto the primary reference
	Off	The clock controller is switched off

Using Option 11 DTI maintenance tools

The tables below provide DTI and clock controller maintenance commands

WARNING

You must disable the clock controller before unseating circuit cards, otherwise the system will initialize and momentarily interrupt call processing.

DTI commands

Below is a quick reference list of important 2 Mb DTI commands in LD 60.

Command	Action
DLBK L	disable "loopback mode" for 2 Mb DTI
RLBK L	enable "loopback mode" for 2 Mb DTI
DISI L	disable 2 Mb DTI when idle
DISL L	force disable 2 Mb DTI
ENLL L	enable 2 Mb DTI
LCNT (L)	list alarm counters
RCNT (L)	reset alarm counters
SLFT (L)	do 2 Mb DTI self-test
STAT (L)	list 2 Mb DTI status

Clock Controller commands

Below is a quick reference list of clock controller commands in LD 60.

Command	Action
DIS CC 0	disable clock controller N
ENL CC 0	enable clock controller N
SSCK 0	status of clock controller N
TRCK XXX	set clock controller tracking. XXX can be:
PCK	track primary clock reference source
SCLK	track secondary clock reference source
FRUN	free run mode

2 Mb DTI tests

Self test/Local loopback

The NTAK10 self-tests when requested in LD 60. This procedure checks the sanity of the on board processors, operation of memory and peripheral hardware as well as per-channel and per-loop loopback.

Before this test is run, the loop must be disabled as follows:

- 1 Disable the NTAK10 using LD 60:

LD 60

DISL L CH

- 2 Run the self-test using LD 60:

LD 60

SLFT L (for the entire loop)

SLFT L CH (for a specific channel)

Local loopback may also be performed on a per-channel basis without having to disable the entire loop. In this case, only the tested channel must be disabled. The procedure for this test is as follows:

- 1 Disable the 2 Mb DTI channel using LD 60:

LD 60

DISL L CH

- 2 Run the self-test using LD 60:

LD 60

SLFT L CH (for a specific channel)

For self testing individual channels, follow the same procedure as above, but use the following commands:

DSCH C CH

SLFT C CH (specific channel)

Table 31

Self-test failure codes for NTAK10 2 Mb DTI

DTI009 loop ch	DTI/PRI loop or channel failed hardware self test. For DTI009 L M E, the output data is L = loop M = N for NI microprocessor M = C for CI microprocessor E = error code for debug purposes.
DTI009C ch	(For System Option 11 only) DTI Card C or channel ch of Card C failed hardware self-test.
	Error codes for NI microprocessor (M=N): 00 = NI self test has finished. 01 = Undefined messout received 02 = Problem with group 2 error handling (invalid level) 03 = NI to CI FIFO full (128 messages lost)
	04 = CI-1 Micro failed to initialize on power-up 05 = NI group 1 error handling - undefined condition found 06 = Bad MESSOUT number 6 encountered. 07 = NI Messout queue is full.

	08 = NI Messin queue full. 09 = NI priority Messin queue is full. 10 = Bad MESSOUT number 10 encountered. 11 = TN = 0 read from regular queue. 12 = TN = 0 read from priority queue. 14 = Bad TN associated with MESSOUT number 14 15 = Bad TN associated with MESSOUT number 15 50 = External RAM in range 880h-8EFH failed (MESSIN queue) 51 = Internal RAM test failed. 52 = Pad RAM test failed. 53 = External RAM test failed.
DTI009C ch	Error codes for NI microprocessor (M=N) continued: 54 = 8253 or DALLAS timer/counter test failed. 55 = Slip counter test failed. 56 = Loopback of TS16 frame 0 failed. 57 = Loopback of non fas TSO failed. 58 = Echo test to CI-1 micro failed. 60 = A07 device failed 61 = Motorola DUART failed 62 = Multiframe loopback test failed 255 = Loss of NI FIFO synchronization (Stop byte = 0 not found). DTI009 error codes for CI microprocessor (M=C): 03 = A complete message was not received from NI micro
	128 = Message received by CI-1 through FIFO requested an un- defined task. 129 = Request for a timed two-state pulse was received, with the TN of TS0 or 16 130 = An attempt was made to set the flag to invoke the pulse tim- er for TS 0. 131 = A request for a task defined under Messout 30 has been re- ceived with the TN of TS 0. 132 = Attempt was made to enable outpulsing TS0 or TS16.

	133 = A Messout 31 has been received for TS 0 or TS 16 with the pulse hold time not = 0. 134 = An attempt has been made to set the bit to invoke the pulse timer for TS 0 or TS 16. 135 = A request for outpulsing was received, but outpulsing data was not downloaded. 137 = A request for PPM counting was received, but the was not downloaded. 138 = A Messout 30 was received requesting a task to be performed for DTI TS 16 which is not allowed.
DTI009C ch	DTI009 error codes for CI microprocessor (M=C): 139 = The 8031 on CHIP RAM failed self test. 140 = The TS 16 signaling RAM and/or the TS 16 pick up buffer failed self test. 141 = The CI-1 micro external RAM failed self test. 142 = Attempt was made to set/clear the flag used to invoke PPM pulse timing for DTI timeslot 0 or 16. 143 = CI-2 micro responded to echo request message but response was in error. 144 = CI-2 micro failed to respond to request echo message. 145 = The request for self test received did not have the TN of TS0 146 = The TN of MESSOUT 26 received was not that or TS 0.
	147 = The TN of MESSOUT 28 received was not that of TS 0. 148 = The TN of MESSOUT 29 received was not that of TS 0. 149 = Upon enabling the DTI card, the CI-1 was unable to write Frame 0, TS 16 with '0B'. 150 = MESSOUT 26 was received with the PPM counting bit (abcd) all equal to zero. 151 = MESSOUT 28 was received with the outpulsing bit (abcd) equal to zero. 152 = CI-2 failed to respond to the CI-1 watch dog message. 153 = The CI-2 failed to respond to five consecutive watchdog messages and is assumed to be out of service. 154 = Messout received requesting the lower nibble of MFAS pattern to be written with something other than '0000'.

DTI009C ch	155 = MESSOUT received requesting '0000' to be written into an 'abcd' state. 156 = MESSOUT received with a TN outside the range shelf 0, card 8-1 unit 3-0. DTI009 error codes for CI microprocessor (M=C): 157 = CI-1, NI FIFO overflowed, and has been cleared. 128 messages were lost. 255 = TS16-DS30X FIFO overflowed, and has been cleared. 128 messages were lost. 147 = The TN of MESSOUT 28 received was not that of TS 0. 148 = The TN of MESSOUT 29 received was not that of TS 0. 149 = Upon enabling the DTI card, the CI-1 was unable to write Frame 0, TS 16 with '0B'. 150 = MESSOUT 26 was received with the PPM counting bit (abcd) all equal to zero. 151 = MESSOUT 28 was received with the outpulsing bit (abcd) equal to zero. 152 = CI-2 failed to respond to the CI-1 watch dog message. 153 = The CI-2 failed to respond to five consecutive watchdog messages and is assumed to be out of service. 154 = Messout received requesting the lower nibble of MFAS pattern to be written with something other than '0000'. 155 = MESSOUT received requesting '0000' to be written into an 'abcd' state. 156 = MESSOUT received with a TN outside the range shelf 0, card 8-1 unit 3-0.
DTI009C ch	DTI009 error codes for CI microprocessor (M=C): 157 = CI-1, NI FIFO overflowed, and has been cleared. 128 messages were lost. 255 = TS16-DS30X FIFO overflowed, and has been cleared. 128 messages were lost.

Near End Trunk loopback test

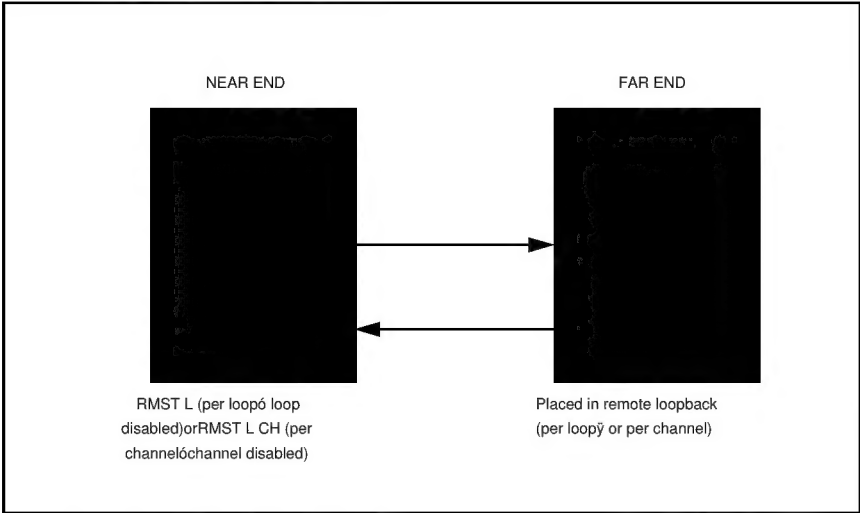
The near end trunk loopback test checks the integrity of the 2 Mb link from the Option 11 to the far end. Either a per-loop or per channel test may be run, with the far end device placed in the respective mode of remote loopback. The procedure for a near-end per-loop loopback test is as follows:

Procedure	Overlay	Command
Disable the 2 Mb DTI card	LD 60	DISL L
Have a technician at the far end place the far end device in remote per-loop loopback.		
Run the loopback test	LD60	RMST L

The procedure for a near-end per-channel loopback test is as follows:

Procedure	Overlay	Command
Disable the 2 Mb DTI channel	LD 60	DSCH L CH
Have a technician at the far end place the channel of the far end device in remote loopback.		
Run the loopback test	LD60	RMST L CH

Figure 75
Near End Trunk Loopback



Far End Trunk loopback test

The far end trunk loopback test checks the integrity of the 2 Mb link from the far end to the carrier interface of the 2 Mb DTI (it does not test the 2 Mb DTI card). Either a per-loop or per channel test may be run, with the near end device placed in the respective mode of remote loopback. The procedures for **per-loop loopback tests** follow:

Procedure: near-end	Overlay	Command
Disable the 2 Mb DTI card	LD 60	DISL L
Place the 2 Mb DTI card in remote per-loop loopback	LD60	RLBK L
Have a technician at the far end run a per-loop loopback test		

Procedure: far-end	Overlay	Command
Disable the 2 Mb DTI channel	LD 60	DSCH L CH
Place the 2 Mb DTI channel in remote loopback	LD60	RLBK L CH
Have a technician at the far end run a loopback test on the channel		

Figure 76
Far End Trunk Loopback

